Being There: Humans and Robots in Public Spaces

Paul Bremner[1], Niki Trigoni[2], Ian Brown[2], Hatice Gunes[3], Chris Bevan[4], Danae Stanton Fraser[4], and Mark Levine[5]

[1] Bristol Robotics Lab, University of the West of England, Bristol.
[2] Department of Computer Science, University of Oxford.
[3] School of Electronic Eng. & Computer Science, Queen Mary University of London.
[4] CREATE Lab, Department of Psychology, University of Bath.
[5] Department of Psychology, University of Exeter.

Abstract. Here we present an introduction to the collaborative research project Being There: Humans and Robots in Public Spaces. In the project we will investigate human-human and human-robot interactions in a sensored public space, using automated affect and behavioural analysis.

Keywords: Human-Robot Interaction, Tele-Presence, Public Space

1 Concept and Research Objectives

The principle virtue of public space is that it allows for strangers to meet. This in turn facilitates a number of public goods: it promotes communication; it allows people to experience difference and thus not to fear it; it lets us learn about the interests and needs of others, it helps us develop shared understandings and common purpose, and finally it allows us to practice and refine the emotions which allow successful citizenship. Research shows that there is significant importance in physical and co-present interpersonal contact to both the development of personal relationships [1] and to the reduction of prejudice between individuals from different communities [2].

An obvious barrier to participation in a physical public space is that of accessibility, whether due to geographical distance or infirmity. A possible solution to this issue is to allow remote participation is tele-operated robots. A robot used in this context would need to be able to convey the social presence of the remote user, allowing them to participate as if they were present. Our EPSRC Digital Personhood Project titled Being There: Humans and Robots in Public Spaces aims to develop a tele-presence user interface that is able to utilise both implicit (e.g., motion capture) and explicit controls to operate several robot platforms (Aldebaran Robotics' NAO, Engineered Arts' RoboThespian, ActivMedia Robotics' PeopleBot). Various aspects of tele-presence will be investigated including varying the appearance, behaviours and capabilities, of each robot platform, as well as the controls and data present on the user interface.

In order to provide quantifiable analysis of robot mediated social interactions in a public space, we will create a model public space to function as a living laboratory in real public venues. We will equip the space with the capacity to track micro-contacts between multiple individuals in real time, and concurrently capture and process information about the emotional and non-verbal communicative qualities of behaviours across time. Accurate, cm-level, location data for individuals in the space is needed to allow capture of micro-interactions between them. We propose to develop a localization system based on low frequency magnetic fields: small magnetic beacons will generate low frequency fields, which will be sensed by low-power miniature receivers carried by individuals and robots. Automatic, behavioural analysis for multi-participant and multi-group environments will be developed using data from physiological, visual and vocal sensory systems, in conjunction with information from the 3D location tracking.

We will utilise sensored environment to perform a programmatic series of behavioural and psychological studies. These studies will focus on social cohesion, pro-social behaviour and trust. A recognised key element of social cohesion and community relations is behavioural synchrony [3], and the space will be curated to focus on this; hence, we will use it as both a focus for the space, and as a key independent variable which we will manipulate for research purposes. We will be able to explore changes in the remote sensing of emotional tone and behaviour in the space, as well as physiological correlates of individual level changes. In addition to these implicit measures, we will also explore participants trust in the relationships between individuals and groups. We will conduct studies with and without the tele-operated robots; thus, we will build a firm understanding both of human behaviour in public spaces, and how robot mediated interactions differ from normal behaviours, and how best to minimise such differences. Additionally, the data gathered from the human interactions will be used in development of the tele-operation system, to determine desired robot behaviours, useful sensory data to feed back to the operator, and additional implicit robot controls.

Our assumption is that the human-robot interaction experiments we will be conducting will provide quantitative benchmark tests for socially interactive robot systems, with respect to a baseline of controlled human behaviours. By using multiple robot platforms, and varying their behaviours and appearance we will gain insight into the requirements for socially acceptable robots. Our hypothesis is that tele-presence will allow us to gain this understanding about socially acceptable robots without the inherent issues from using autonomous systems in a public space, while still being informative to the design of autonomous systems.

References

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